

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: Fritz Scholz, Ulrich Hasse

Serial No.:

Examiner:

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Group:

For: METHOD OF RECOVERY OF METALS FROM ETCHING SOLUTIONS

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Carl L. Johnson

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**Preliminary Amendment**

Honorable Commissioner of Patents and Trademarks  
Washington D. C. 20231

Sir:

Please amend the above-identified application as follows:

In the Specification

Please substue new page 6 for old page 6,

REMARKS

The enclosed Preliminary amendment is included to change the form of the equation usage from a  $\Delta$  symbol to a  $\rightarrow$  symbol. Both symbols represent that a change that occurs, however, the inventors prefer the  $\rightarrow$  symbol.

Respectfully submitted,

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By



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Once the spent etching solution 14 is subjected to the iron particles the spent etching solution 14 with the precipitate therein is directed to a separator 26 through a conduit 25. The metal powder can now be removed or separated from the solution with a separator through a process of sedimentation, centrifugation, filtration or similar process.

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In the preferred process the nickel powder is directed from separator 26 to a container 28 through a conduit 27 and the copper powder is directed from the separator 26 to a container 30 through a conduit 29. The copper powder and nickel powder can then be reused in the formation of copper and nickel metals. The spent etching solution, which now  
10 has the copper and nickel removed, flows into a container 32 through a conduit 31.

The spent etching solution in container 32 can now be regenerated to form a fresh batch of etching solution. For example, with the spent etching solution comprising a ferrous chloride solution a source of chlorine 35 can direct chlorine into the ferrous chloride  
15 solution through a conduit 36 to convert the ferrous chloride solution to a ferric chloride etching solution. A conduit 38 and a pump 40 pump the batch of regenerated etching solution to the fresh etching solution 9 contained in container 8.

Thus in the present invention the metal iron precipitates nickel and copper from used or  
20 spent etching solutions in the form of a metal powder that separates from the iron without forming adhering layers or large inter grown metal deposits. The process is based on the reducing power of metallic iron and it is believed the reactions for nickel and copper can be summarized as follows:  $\text{Ni}^{2+} + \text{Fe}_{\text{metal}} \rightarrow \text{Ni}_{\text{metal}} + \text{Fe}^{2+}$  and  $\text{Cu}^{2+} + \text{Fe}_{\text{metal}} \rightarrow \text{Cu}_{\text{metal}} + \text{Fe}^{2+}$  while the residual ferric chloride etching solutions is reduced according to the  
25 equation  $\text{Fe}^{3+} + \text{Fe}_{\text{metal}} \Delta 3\text{Fe}^{2+}$ . Thus the reduced solution contains  $\text{Fe}^{2+}$  ions and chloride ions. The solution can be oxidized by chlorine to produce a fresh Ferric chloride etching solution for further use.